RSM Array™ 2000

Phase 1 and Phase 2

Just the Fact

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Introduction

The RSM Array 2000 represents a new level of performance, availability and redundancy for Sun's mission critical enterprise customers. Expanding on the highly successful SPARCstorage™ Array 112 and (SSA) the 214 RSM series products. The new RSM Array 2000 offers the following key new features:

Phase 2 Features:

- Improved H/W RAID 5 performance with UltraSCSI inter-controller communication
- Dual host and multi-initiation designed to support SunClusters.
- Box sharing across two independent Solaris host
- Daisy chain two RSM Array 2000
- Supports UE10000 domain reconfiguration
- Enhanced RAID Manager 6.1 features
- Open Ultra SCSI host interface for use on HP-UX and NT (12/97)

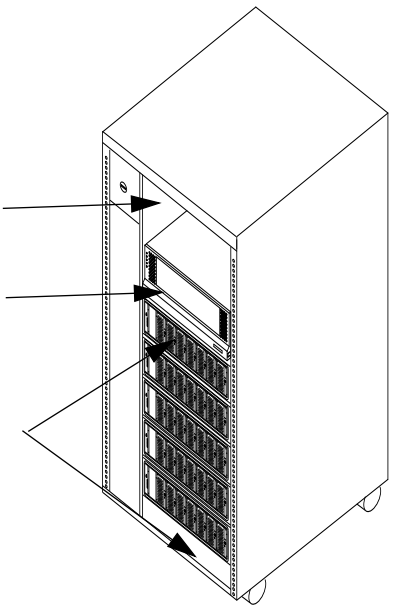
Phase 1 Features:

- New high performance controller-based RAID system with the highest RAS features
- Superior RAID 3/5 performance due to the intelligent caching controllers
- Dual-active RAID controllers (2 included) for automatic failover
- Simple setup and administration using RAID Manager GUI
- Configurations with 63 GB to 147 GB storage using 4.2 GB 7200rpm disks
- Configurations with 136 GB to 318 GB storage using 9.1 GB 7200rpm disks
- RSM disk trays with one SEN card per tray
- Open ultra SCSI host interface for use on non-Sun/Solaris systems.
- RAID-5 sequential read at 60.5 MB/sec - sequential write at 65 MB/sec
- RAID-0 random write performs at > 6800 I/O per sec

Space for optional 400 GB 8mm Tape Library (X6225A)

RSM Array 2000 controller module with two RAID controller boards.

5 RSM trays with drive modules & 5 SEN cards



SUN™ RSM Array™ 2000 Positioning

The SPARCstorage Array has been wildly successful and has made Sun the nu MBer one storage array provider in the Unix marketplace. The RSM Array 2000 increases the breadth of storage options for Sun customers by providing an additional level of RAS. The RSM Array 2000 is a controller-based (hardware) RAID solution that provides for superior RAID-5 performance and minimal cost for data protection. System I/O throughput improves because the controller frees the CPU from I/O parity calculations.

Storage arrays have become the single most important component in a server system running mission critical applications. Data must be available without interruption to system operation and reliable without data corruption. RSM Array 2000 data availability is 99.99% by using hotplug controllers, power, and cooling. Hotplug components let users service the system without bringing the system down. RSM Array 2000 is scalable. The maximum configured capacity is 11 Terabytes using 9.1 GB drives and daisy-chaining two RSM Array 2000 systems.

Applications that depend on random I/O operations database servicing, file servicing, OLTP, and decision support benefit with higher random read/write performance. Applications that depend on sequential I/O operations like data warehousing, imaging, multimedia, video, and data acquisition will benefit from the higher throughput through the differential Ultra SCSI host interconnection.

Basic Positioning: Disk Arrays for Different Needs

Sun designs the right storage array your customer.

RSM 214	Sun RSM Array 2000	Photon
• Fibre channel to host 25 MB/sec, Full Duplex • Remote Storage	• Ultra SCSI to host 40 MB/sec • Datacenter Storage	• FCAL to host 100MB/sec • FCAL drives • Datacenter Storage
• Hotplug drives	• Hotplug drives	• Hotplug drives
• Fully redundant disk tray & scalable to any level of redundancy	• Fully redundant dual active controllers, power & cooling	• Fully redundant, dual power & cooling
• Host based RAID • Volume Manager • Mirrored Applications	• Controller-based RAID • RAID Manager • RAID 3/5 Applications	• Host-based RAID • Veritas Volume Manager •
• Lower $/ MB	• Fastest RAID 5 performance	• Highest overall performance

SPARCstorage Array Model 112/114

The SSA Model 112/114 is ideal for customers who use RAID 1 (mirrored) configurations and want the best price/performance. This model uses warm plug drives where hot spares can be configured with the Volume Manager software. The fibre channel to host interconnection is ideal for applications that require remote storage.

The SSA 114 is configured with up to 126 GB of disk capacity using thirty 4.2 GByte disk drives. Sun's Ultra Enterprise 6000 supports up to sixty Model 114 systems to provide over 10 Terabytes of storage.

SPARCstorage Array RSM 214/219

The SSA RSM 2xx is designed for customers who need a lower cost per megabyte ($/ MB) storage solution for mission critical applications. The RSM disk trays use hotplug drives for higher availability without deferring servicing of failed drives. Mirrored and hot spare drives can be configured with Volume Manager software. The fibre channel to host interconnection is ideal for applications that require remote storage.

The SSA RSM 214/219 is configured with up to six RSM disk trays. The six trays hold up to forty-two 9.1 GB 5400rpm hotplug disk modules or a maximum of 382 GB of storage per rack. Sun's Ultra Enterprise 6000 supports up to forty RSM 214 systems to provide over 10 Terabytes of storage.

RSM Array 2000

RSM Array 2000 is Sun's controller-based RAID system for RAID-5 performance. There are dual differential Ultra SCSI (40 MB/sec burst rate) channels to the host that permit automatic failover to the second active controller. RSM Array 2000 will be Sun's highest RAS storage solution designed for mission critical datacenter applications. The system is fully redundant with dual hotplug controllers, power, cooling.

The same RSM disk trays are designed into both the SSA 2xx and RSM Array 2000. Five RSM disk trays attach to 5 SCSI channels on the RAID controller module. The same 4.2 GB 5400rpm, 4.2 GB 7200rpm, or 9.1 GB 7200rpm hotplug disk modules are customer serviceable without interrupting system operation. With the Ultra™ Enterprise™ 10000, 6000, customers can configure over 10 Terabytes of storage.

Sun Enterprise Network Array A5000 (Photon)

The Sun Enterprise Network Array A5000 is a very scalable storage subystem providing the FCAL host interface and FCAL performance drives. It's configurations scale from 45 GB to over 500GB in a rackmount configuration.

RSM Array 2000 Positioning (cont'd))

Positioning by Host Platforms

	Platform Positioning	Advantages
Enterprise Network Array A5000	– Ultra Enterprise 10000, 6000, 5000, 4000, SPARCcenter™ 2000E, SPARCserver™ 1000E.	– Host-based RAID – FCAL performance – Highest RAS with fully power, cooling and drive modules
RSM Array 2000	– Ultra Enterprise 10000, 6000, 5000, 4000, 3000, 2, SPARCcenter™ 2000E, SPARCserver™ 1000E. – Post FCS UE 450	– Controller-based RAID for highest RAID-5 performance – Highest RAS with fully redundant controllers, power, cooling and drive modules – Easy to service, controller and drives – Friendly GUI for RAID management and recovery
SSA RSM 2xx Series (RSM 214/219)	– SPARCcenter 2000E, SPARCcluster™ 2000PDB, and Ultra Enterprise servers that will grow to over 500-1000 GB	– Greater total system capability than Model 100 Series – Easy to service and eliminates need to defer maintenance of failed drives – Competitive performance – Ideal for mission critical data – High RAS characteristics

RSM Array 2000 Competition

- Competing Products: DG Clariion 2900, DEC Storageworks 410, EMC Symmetrix 5000
- RSM Array 2000
  - Very competitive in cost/ MB with products by DG, DEC, and EMC. It is scalable, and offers 318 GB of data capacity per enclosure and scalable to 11 Terabytes.
  - High performance:it also offers high performance, with approximately 6579 IOPS for random writes with 100% hits to cache and a sustained RAID-5 data rate of approximately 60.5 MB/sec per array.
  - Integrated and designed for Sun/Solaris mission-critical environments
  - Sun quality and integration testing provides dependable solution

RSM Array 2000 Positioning (cont'd)

Disk Array Competitive Matrix

Product		Sun	DG	DEC	EMC
Feature		Sun RSM Array 2000	Clariion 2900	Storageworks 410	Symmetrix 5000
Performance	RAID-5 100% cache	6579 IOPS random read 2 controllers	3000 IOPS	2600 IOPS 0.5KB	4000 IOPS random r/w 4 channel directors
	RAID-5 0% cache	60 MB/sec per controller seq. read 2 controllers	N/A	N/A	32 - ~80 MB/sec with 4 channel directors
RAS	RAID Levels	H/W 0, 0+1, 1, 3, 5	H/W 0, 0+1, 1, 3, 5	H/W 0, 3, 5	H/W 1, S
	Hot Swap Disks	Yes	Yes	Yes	Yes
	Hot Swap Pwr	Yes	Yes	Yes	Yes
	Hot Swap Fan	Yes	Yes	Yes	Yes
	Auto Hot Spare	Yes	Yes	Yes	Yes
	2 Controller	Yes	Yes	Option	No
	Early Failure Warning	Yes	No	No	Yes
	Phone Home	Yes	Yes	No	Yes
Scalability	Capacity Per Enclosure	147 GB/4 GB 318 GB/9 GB	80 GB/4 GB 182 GB/9 GB	103 GB/4 GB N/A	1,088 GB/9 GB
Software	Operating System	Solaris	HP-UX, Solaris, AIX, NT, Netware, OS/2, OS/400, SCO, IRIX	DEC Unix, Solaris, AIX, NT, Netware	Solaris, HP-UX, AIX, NT, OS/400, Vines, Netware
	Layered Application	Required	Required	Required	Required
Host Interface		Two 40 MB/sec	20 MB/sec DSCSI	20 MB/sec SCSI	20 MB/sec SCSI
Drive Array Interface		5 channels to disk F/W Differential	5 channels Fast SCSI 10 MB/sec	6 channels Fast SCSI 10 MB/sec	6 channels Fast SCSI 10 MB/sec
Cache		128-256 MB	8 MB -128 MB	32 MB - 256 MB	4GB

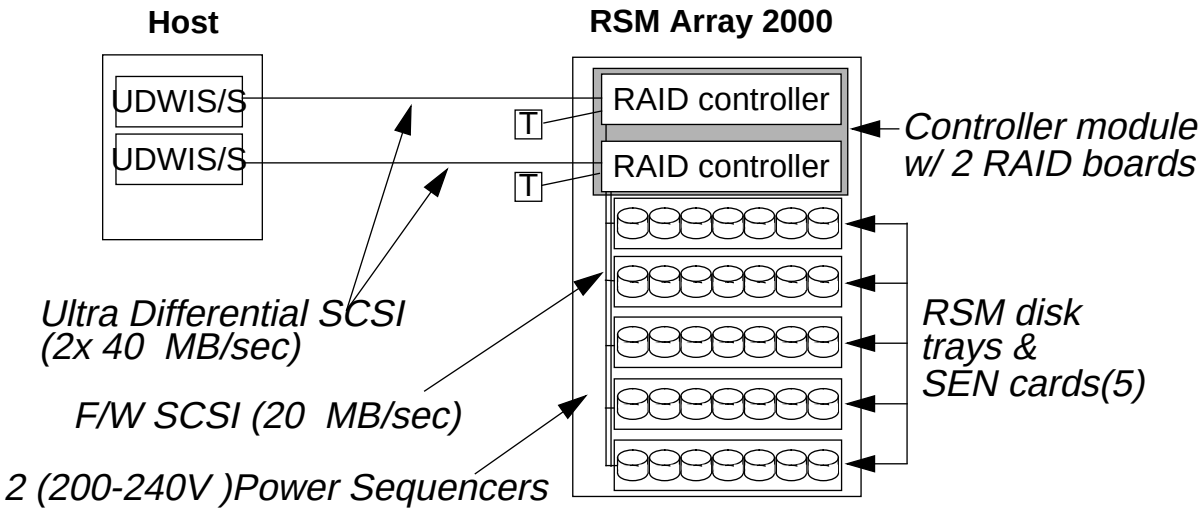
RSM Array 2000 Positioning (cont'd)

RSM Array 2000 Key Facts

RSM Array 2000 is a high performance, high availability solution using a pair of RAID controller boards. It is configured as a system with:

- RAID controller module (with 2 RAID controller boards standard)
- RAID Manager (software)
- RDAC driver
- five RSM disk trays with five SEN cards
- two power sequencers
- and two 200-240V power cables

All components are redundant and mounted in an Enterprise expansion rack. Customers can order several system configurations: 1) configuration with five RSM trays with 3 drives per tray 2) or configuration with five RSM trays with 7 drives per tray (up to 15 or 35 per rack, respectively).



RSM Array 2000 Positioning (cont'd

RSM Array 2000 Key Features and Benefits

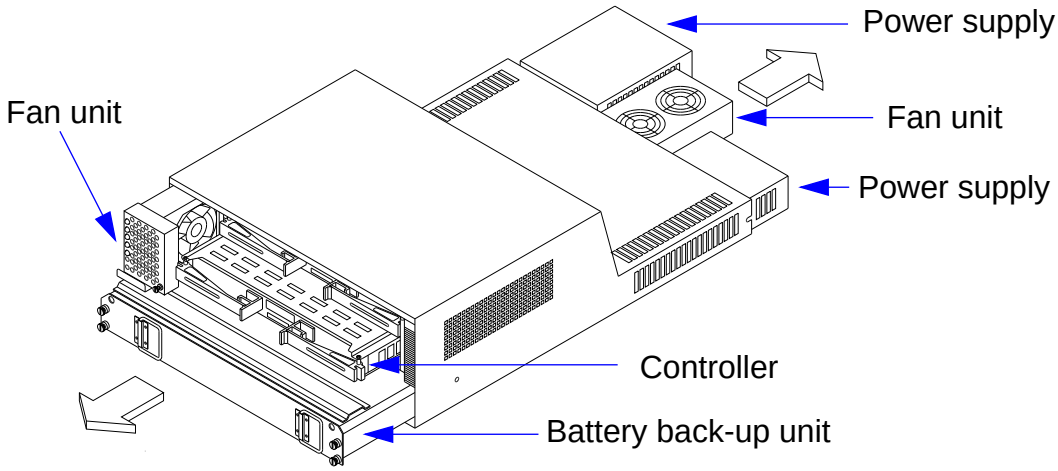
• Phase 2 Additional Features	• Benefits
– Dual host and multi-initiation for SunCluster 2.0	– High availability and automatic failover of the host and disk array. Redundancy reduces the frequency and duration of outages.
– Two host share access to both controllers of the disk array. Hot plug controllers, power, fan, and disks	
– Box sharing across two independent controllers. Specific controller and LUNs assigned to independent hosts. No controller failover	– Two Solaris hosts can share the same RSM Array 2000. .
– Daisy chain two RSM Array 2000 disk arrays.	– Double the capacity of storage to your system; up to 636-GB storage per pair of host adapters.
– Dynamic reconfiguration supported on the Ultra Enterprise 10000	– Move the RSM Array 2000 across UE10000 domains without a domain reboot
– Enhanced RAID Manager 6.1 Software (GUI)	– Increased RAID 1 LUN to 15+15 drives. – Added information on mirrored drives – Frozen node names mapping LUNs to controllers – Customized name for each RSM Array 2000 module
– User Defined Module selection/ removal.	– Allow users to assign a name to each RSM Array 2000 disk array.
– Year 2000 compliance	– Continued operation through the year 2000 without redesigning IS system.
– Ultra-SCSI communication between two controller boards	– Increased RAID performance when cache mirroring is enabled

• Phase 1 Features	• Benefits
– Dual controller based RAID	– Controller-based RAID delivers higher performance by decreasing CPU drain for I/O processing – Dual active controller provides higher bandwidth and automatic failover to the second controller
– RAID Manager GUI & CLI	– Supports automatic failover to the second controller – Easy configuration, management and recovery of RAID implementation
– RAID 0, 1, 0+1, 3, 5	– High data availability for mission critical data center applications – RAID-5 performance multiplies the power of the industry's most popular line of scalable Unix servers: Ultra Enterprise servers, Sun SPARCservers, Sun SPARCcenters

• **Phase 1 Features**	• **Benefits**
– Dual hotplug controllers, power supplies/cooling, power sequencers, and RSM disk trays	– Full redundancy provides the highest availability for a mission critical data center. If one controller fails, I/O processing will automatically fail-over to the other – High serviceability: customers can immediately replace components without calling for service – Each power supply can support the power requirement for both controller boards – Hot plug drive modules permits immediate servicing without system down time
– 128 MB to 256 MB mirrored data cache memory	– Increase performance by enabling fast writes to the data cache
– Battery backup for cache memory	– Protects data written to cache up to three days during a power failure
– Maximum of 5 RSM disk trays offered in 2 configurations: 15 or 35 RSM drive modules per rack	– Configured up to 318 GB of storage per rack using 9.1 GByte drives – Configured up to 147 GB of storage per rack using 4.2 GByte drives
– Five SEN cards in the RSM disk trays	– Environmental monitoring and reporting via SCSI for temperature, voltage, fan failure, power supply status, and complete health check of each disk tray
– Rack mounted on Enterprise rack	– Storage solution for datacenter application
– Open SCSI host interface	– Protect storage subsystem investment by providing future interoperability on heterogeneous host environment.
– 2 Ultra SCSI differential interface to the host	– Provides up to 80 MB/sec data transfer across two host connections

RAID Controller Module Key Facts

The heart of the RSM Array 2000 system is an intelligent RAID controller module with two active RAID controller boards. There are redundant power supplies, cooling units and backup batteries.



RAID Controller Module Tech Facts

- Intelligent RAID controller module:
  - Two RAID controller boards, please refer to the section “RSM Array 2000 Controller Board.”
  - One battery cage provides a minimum three days of power backup for cache memory. The battery module uses redundant batteries and charger circuits. Battery shelf life is rated for 2 years.
  - Two hotplug power supplies rated at 240V, 1.0 Amp, and power-factor corrected (PFC). PFC smooths out input current voltage.
  - Redundant rear fan units for the power supplies and redundant front fan units for the controller boards.
  - The controller module LEDs indicate: unit power, power supply fault, fan fault, controller fault, fast write cache).
- The two controller boards, RAID Manager GUI, and RDAC driver are components required for automatic failover. The RDAC driver senses a controller failure and automatically re-routes active I/Os to the other controller. Please see the section titled “RAID Manager” for more information.
- Controller SCSI interface:
  - The controller to host interconnection are 2 ultra SCSI differential (80 MB/sec available data bandwidth).
  - The controller to disk array interconnection is through 5 differential F/W SCSI (20 MB/sec per channel).

RAID Controller Module Key Facts (cont'd)

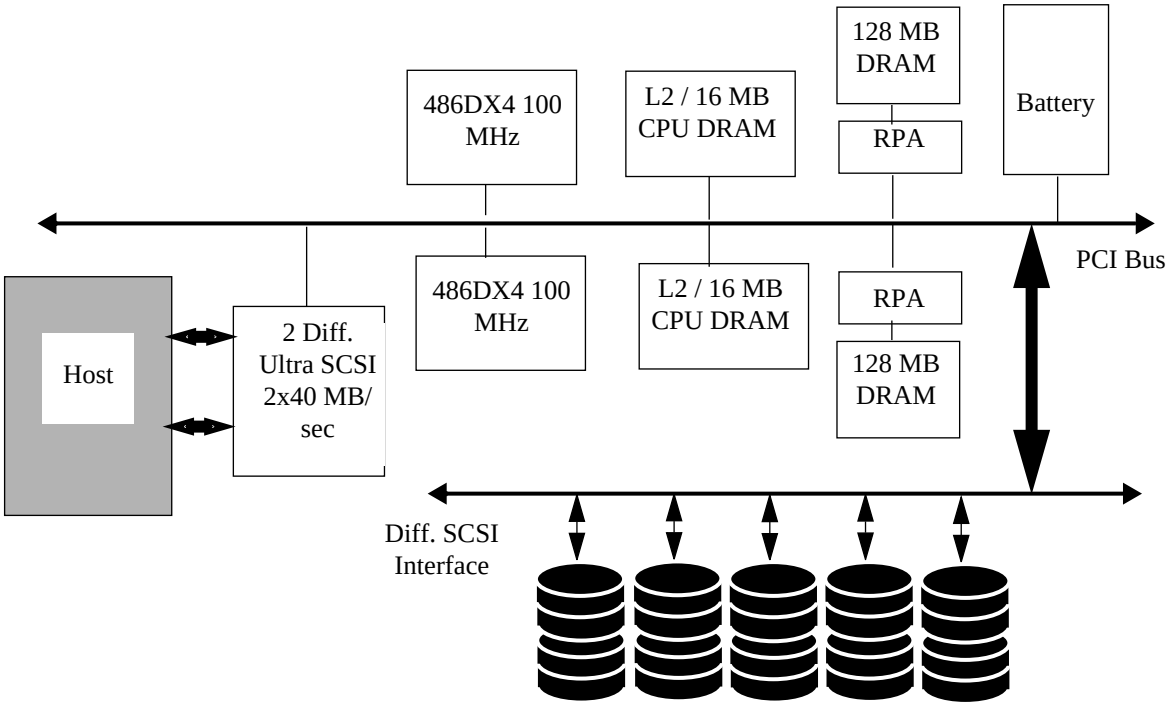
- High RAS features - these are redundant components in the RSM Array 2000 system and xoption:
  - The RAID controller module uses 2 controller boards, and 2 cooling units, 2 power supplies.
  - The battery pack includes redundant battery cells and chargers.
  - The RSM disk trays also include dual fans and power supplies.
  - The RSM Array 2000 expansion rack uses 2 power sequencers, each connecting to separate wall outlets and separate power supplies supporting the controller modules and RSM drive trays.
- RSM Array 2000 requires a 220 Volts or 240 Volts power source.
- The RSM Array 2000 and the SPARCstorage Arrays may coexist on the same server system but not on the same SCSI chain.
- Customers using the SSA RSM 214 can upgrade their system to RSM Array 2000 by replacing the Model 200 controller with the RSM Array 2000 controller module and attaching five of the six RSM disk trays to the five SCSI channels. The RSM Array 2000 controller module is supported on both the Enterprise and the Datacenter expansion (Dragon) racks. Customers may need to buy a second power sequencer for their Enterprise expansion rack. All power cables required for installation are included in the xoption packages.
- RSM Array 2000 is supported on Solaris™ 2.4, 2.5, 2.5.1 or later releases.
- The RSM Array 2000 has a centerplane circuit board where the RAID system components interconnect:
  - 2 host-in connectors for attachment to the host bus adapters. The host interconnection is through the PCI interface using one 80 pin high-density connector. The host interface operates as 8 or 16 bit, synchronous, fast synchronous, or asynchronous differential.
  - 2 host-out connectors which require two passive differential terminators. When daisy chainning 2 RSM Array 2000 systems is supported on the same bus, the terminator is installed on the second RSM Array 2000.
  - 5 F/W SCSI connectors for attaching to 5 RSM disk trays. The disk array and daughter card interconnection is through the PCI interface. There are five array SCSI interfaces. These are 8 or 16 bit, fast synchronous or asynchronous, differential SCSI-2.
  - Host SCSI ID jumpers is selectable on the backplane.

• **SCSI ID**	• **Device**
– 4	– Controller 2
– 5	– Controller 1
– 6	– System drive
– 7	– Internal drive
– 15	– SEN card

  - The backpanel also provides interconnection to the battery module and power supply.
  - Controller module interconnection: two controller boards connect to the backplane using a 600 pin TBC+ connector for all SCSI and subsytem interconnection.

RSM Array 2000 Controller Board Key Facts

The core of the RAID controller board is a 486DX4 100 MHz processor on each board. High availability features include automatic failover to a second controller board, dual hot plug controllers, power supplies, fans, and battery backup for mirrored cache. The controller supports RAID 0, 1, 0+1, 3, and 5.



RSM Array 2000 Controller Board Tech Facts

- Two intelligent hardware controllers support RAID 0, 1, 0+1, 3, and 5. The controller microprocessor does all the RAID calculation for I/O and volume management. This improves system performance by reducing the CPU load and I/O traffic between the host and the array.
- The 486DX4 is a 100 MHz processor is a socketed PGA part.
- Each controller board includes: 16 MB of CPU memory, 64 MB mirrored data cache memory, and 512K of Level 2 cache. Below are the possible configurations for cache memory.

	Per Controller Board	Maximum on 2 Boards
– Base Configuration	– 16 MB microprocessor cache (maximum) – 64 MB data cache – 512K Level 2 cache (maximum)	– 32 MB microprocessor cache – 128 to 256 MB mirrored data cache – 1024K Level 2 cache (maximum)
– Upgrade	– Add-on 64 MB data cache	– Add-on 128 MB data cache

- The Level 2 CPU processor cache has 512 KBytes SRAM memory for SCSI command queueing.
- RSM Array 2000 is configured with 64 MB of DRAM per controller for data cache. Users can add up to a maximum of 128 MB per controller (maximum 256 MB on two controllers). The data cache uses 70ns DRAM organized x36 in 72-pin package. The data cache is controlled by the RPA (RAID Parity Assist chipset). Each board has four SIMM sockets for data cache memory. There are 4 slots for data cache memory and the slots need to be filled one pair at a time. The first 2 slots (Bank 1) need to be filled first. The add-on memory goes into the second 2 slots (Bank 2).
- The controller module has 10 LEDs visible from the front of the panel. They indicate the status of the controller module.

RSM Array 2000 System Architecture (cont'd)

RSM Tray & Hotplug Disk Module Key Facts

The same RSM disk trays are used in both the RSM Array 2000 as well as the SPARCstorage RSM 214/219 systems. This disk tray is customer serviceable with hotplug disk modules as well as hotplug redundant power and cooling.

RSM Array 2000 System Architecture (cont'd)

RSM Tray & Hotplug Disk Module Tech Facts

- Each RSM disk tray holds a maximum of seven hotplug disk modules. These are the same disk trays used in the SPARCstorage RSM 214/219. Customers can use their existing RSM disk trays with the RSM Array 2000, however, they need to add 5 SEN cards to the five RSM disk trays. Once updated, connect the five trays to five disk SCSI channels on the controller module.
- 3.5" form factor drives are enclosed in a plastic drive module for easy installation and removal from the RSM disk tray.
- Redundant power supplies and cooling. Each power supply unit is capable of running in non-degraded operation in the event of a power supply failure. A single power supply can handle the start-up power surge for all disks. In addition, a power supply can be replaced while the RSM tray is in operation. Each cooling unit can maintain operating temperatures in the event of a single fan failure.
- The drives use SCA-2 connectors in which the ground leads make contact first for hotplug support. This ensures electrical hotplugging. The cable free drives plug directly into backplanes to provide higher reliability. A 68-pin connector is used for attachment to the RAID controller module.
- SCSI environmental sense (SEN) card enables the host system to get environment status over the SCSI bus, and provides control over individual drive fault indicators to the host system.
- The controller polls the SEN card every 10 seconds and the SEN card responds via SCSI.
- The OVRTEMP LED comes on when the internal thermistor senses heat rise has reached about 46 to 47.5 degree in the RSM tray enclosure.
- heat rise has reached about 46 degrees
- RSM Array 2000 will be available in the following system configurations:
  - 35 x 4.2 GB 5400rpm drive configuration
  - 15 x 4.2 GB5400rpm drive configuration is the entry configuration that allows users to grow their subsystem as their business grows.
  - 35 x 4.2 GB 7200rpm drive configuration
  - 15 x 4.2 GB 7200rpm drive (only build to order configuration for UE 6000/5000/4000/3000/2, SC2000E/2000, SS 1000E/1000))
  - 35 x 9.1 GB 7200rpm drive configuration
  - 15 x 9.1 GB 7200rpm drive configuration

RSM Array 2000 System Architecture (cont'd)

Differential SBUS/SCSI Host Adapter Key Facts

RSM Array 2000 is supported on the differential Ultra SCSI host bus adapter (UDWIS/S) as well as the differential F/W SCSI host bus adapter (DWIS/S) for the host interface. If performance is critical, use the UDWIS/S host bus adapter.

Differential SBUS/SCSI Host Adapter Key Features and Benefits

- **Features**
  - UDWIS/S with ISP 1000U chip
  - DWIS with ISP 1000 chip
- **Benefits**
  - Differential Ultra SCSI synchronous transfer rate of 40 MB/sec per host bus adapter.
  - Differential F/W SCSI synchronous transfer rate of 20 MB/sec per host adapter.

Differential Ultra SCSI Host Bus Adapter (UDWIS/S) Tech Facts

- RSM Array 2000 using a UDWIS/S host bus adapters requires Solaris 2.4, 2.5, and 2.5.1 at FCS. Later versions of Solaris will be supported after FCS.
- The UDWIS/S host bus adapter allows data transfer up to 40 MB/sec.
- The UDWIS/S host bus adapter is only supported in configurations with the RSM Array 2000 system.
- The UDWIS/S host bus adapter cards are rated at an average of 10.5 Watts (15 Watts maximum).
- The UDWIS/S host bus adapter cards measure 5.776" x 3.3" (146.70 mm x 83.82 mm).
- The UDWIS/S host bus adapter weighs less than 1 lb. (0.45 Kg).
- UDWIS/S/S and DWIS/S host adapters cannot be mixed on the same RSM Array 2000 system.

Differential F/W SCSI-2 Host Bus Adapter (DWIS/S) Tech Facts

- Customer who already have a DWIS/S host bus adapter and don't need the Ultra SCSI performance, RSM Array 2000 will support the DWIS/S card.
- RSM Array 2000 using DWIS/S host bus adapter with RSM Array 2000 requires Solaris 2.4, 2.5, and 2.5.1 at FCS. Later versions of Solaris will be supported after FCS.
- The DWIS host bus adapter allows data transfer up to 20 MB/sec.
- The DWIS/S host bus adapter cards are rated at an average of 10.5 Watts (15 Watts maximum).
- The DWIS/S host bus adapter cards measure 5.776" x 3.3" (146.70 mm x 83.82 mm).
- The DWIS/S host bus adapter weighs less than 1 lb. (0.45 Kg).

RSM Array 2000 System Architecture (cont'd)

Enterprise Expansion Rack Key Facts

The Enterprise expansion rack is the same as that used in all Ultra Enterprise servers and the RSM 214 subsystem.

Enterprise Expansion Rack Key Features and Benefits

- **Features**
  - Dual power sequencers.
  - Standard expansion cabinet
- **Benefits**
  - Full redundancy for high mission critical applications. Each rack will have two power sources from separate wall outlets.
  - Same expansion cabinet used for Ultra Enterprise servers and the RSM 214.
  - After the RSM Array 2000 system is configured, a space of about 11 inches high remains that can accommodate a rack mounted an optional 400GB 8mm tape library (X6225A).

Enterprise Expansion Rack Tech Facts

- The Enterprise expansion rack measures height 143 cm (48") x width 77 cm (30") x depth 99 cm (39").
- The Enterprise expansion rack is equipped with two power sequencers. Each power sequencer is rated at max 4200 Watts.

RSM Array 2000 Software Architecture (cont'd)

RAID Manager Key Facts

The RAID Manager application is a graphical user interface (GUI) that lets users visually access and configure a RAID implementation in the disk subsystem. The RDAC (Redundant Dual Active Controller) driver makes it possible for automatic failover to the second controller when one fails.

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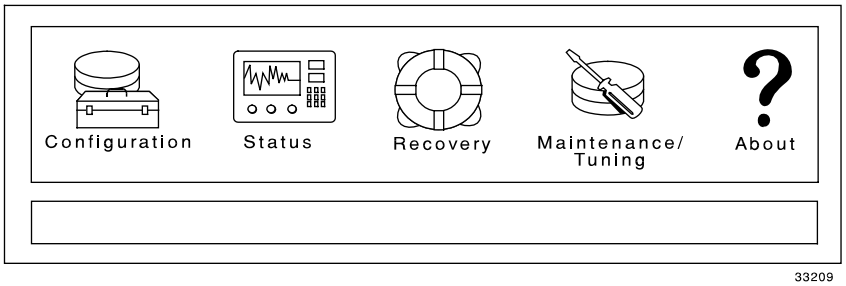


RAID Manager Features and Benefits

- **Features**
  - Configuration Application
  - Status Application
  - Recovery Application
  - Maintenance/Tuning Application
- **Benefits**
  - Flexible RAID configuration
  - Locate a drive group
  - Create LUNs and hot spares from unassigned drives or add LUNS to an existing drive group
  - Delete LUNs in a drive group or a hot spare drive
  - Real-time view of log files with system information about failures, parity checks, and system events
  - Perform health check on RAID modules.
  - View the status of LUN reconstructions or change the LUN reconstruction rate
  - On-line instructions for easy restoration of failed components in a RAID module
  - Manual parity check/repair of LUNs
  - Manual recovery of drives and controllers You can fail, reconstruct, and revive drives; format and revive LUNs, and set controllers to (Active/Passive or Active/Active)
  - Automatic LUN reconstruction
  - Change LUN Reconstruction Rate
  - Balance LUNs between active controllers
  - View/set cache parameters for each LUN
  - Upgrade controller firmware
  - Change/set automatic parity check
  - Manage error log file

RAID Manager Tech Facts

- The RAID Manager software includes both GUI (graphical user interface) and command line interfaces for configuration, monitoring, and maintenance/tuning of the RAID configuration.
- The RAID Manager software also includes the Redundant Dual Active Controller (RDAC) driver, a kernel-level driver that manages automatic controller failover to the other controller on the array. The RDAC driver sits logically above the Solaris SCSI driver in the Solaris kernel.
- A RAID module is a set of associated drives, controllers, power supplies and cooling unit.
- The Solaris operating system sees each LUN as one virtual disk drive. Under Solaris, a maximum of 8 LUNS are permitted on single or dual-active controller environments and up to 64 partitions.
- A drive group is a logically grouped set of drives. Drive groups will renu MBer automatically on the next reconfiguration boot after configuration changes.
- RAID Manager uses the standard device code (cX tY dZ s0)
  - cX = host bus adapter with a maximum of 32 LUNS per host bus adapter and two daisy-chained RAID controller modules (4 controller boards 8 LUNs per controller under Solaris).
  - tY = the controller SCSI ID. This is limited to 8 under Solaris 2.5.1 and earlier releases.
  - dZ = LUN
  - s0 = this is the LUN slice nu MBer. Under RAID Manager, the slice is always "0."
- Hot spares, disks that contain no data and act as a standby in case a drive fails, are supported by RAID Manager. Data is returned automatically to the original disk once a failed disk has been replaced, ensuring the original performance is maintained; the spare disk is available again as a global hot spare.
- RAID Manager write cache options let the user customize how data is cached:
  - Write caching - data can be written from the host to the controller's cache by enabling "Write Caching." This improves overall performance because the write operation is considered completed by the host once it is written to cache.
  - Write cache mirroring - when enabled, cached data is written to the cache memory of both controllers so that when a controller fails, the second controller completes all outstanding write operations.
  - Cache without batteries - users can enable write caching when the batteries are discharged.
- Fast/writes to mirrored cache is enabled by default. Read block from cache memory lets the data block stay in cache until another block needs the space. Write block from host to cache memory lets the data block remain in cache memory until the data is written from cache to the media.
- Read ahead cache for fetching pages of data from sequential disk addresses.
- Manual load balancing is provided to enable an administrator to balance the I/O load and improve overall system performance. The software also allows selection of various data cache settings such as write caching (to improve performance) and write cache mirroring (to protect data in the event of a controller failure). Fast writes to the data cache are enabled by default.

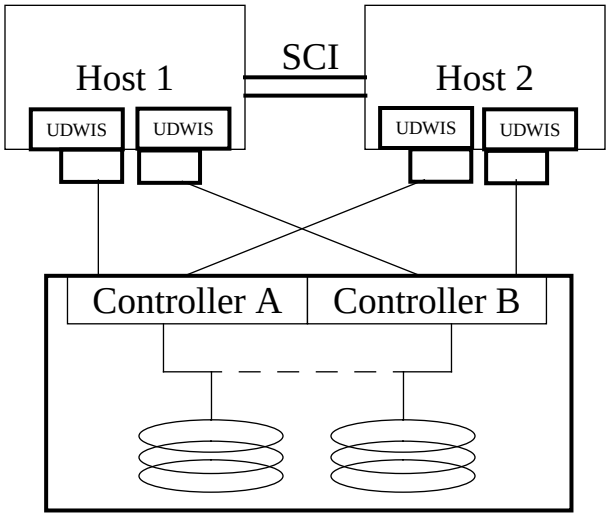
RAID Manager Tech Facts (cont'd)

- On-line instructions for easy restoration of failed components are provided by the GUI Recovery Guru. The Recovery Guru provides step-by-step failure recovery guidance to ease administration and minimize the possibility of administrator error.
- Message/event logging is provided by default, and can be customized to meet customer needs.
- Parity checks are run automatically to verify that there are no parity errors. If any parity errors are found, the parity is automatically repaired and rewritten to disk.
- Simple Network Management Protocol (SNMP) support is provided, enabling integration with network management tools such as Solstice SunNet Manager.
- RAID Manager enables on-line rollover upgrades of the controller firmware. All logical units are rolled over to one controller, the new revision of the firmware is downloaded to the idle controller, then the logical units are rolled back.
- The RSM Array 2000 is configured with a default RAID-5 configuration:

	35 Disk Configuration (5 trays x 7 disks/tray)	**15 Disk Configuration (5 trays x 3 disks/tray)**
Default Configuration	6 x (4+1) = 30 (RAID-5) 1 x (2+2) = 4 (RAID 1+0) 1 x GHS (global hot spare) = 1	2 x (4+1) = 10 (RAID-5) 1 x (2+2) = 4 (RAID 1+0) 1 x GHS = 1

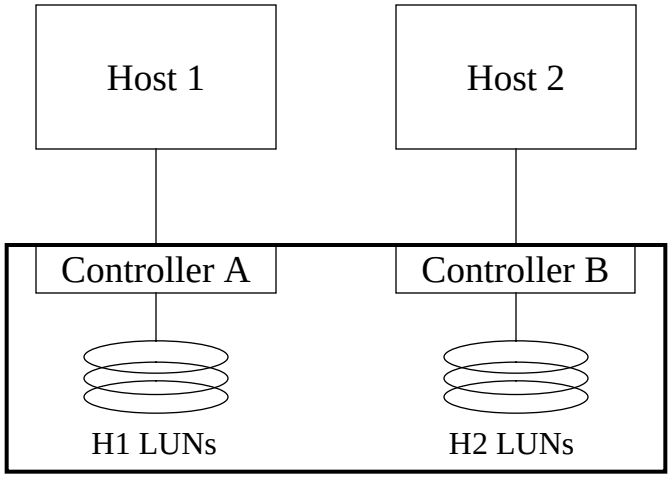
Multi-initiator Clustering

HA/Multi Initiator Configuration



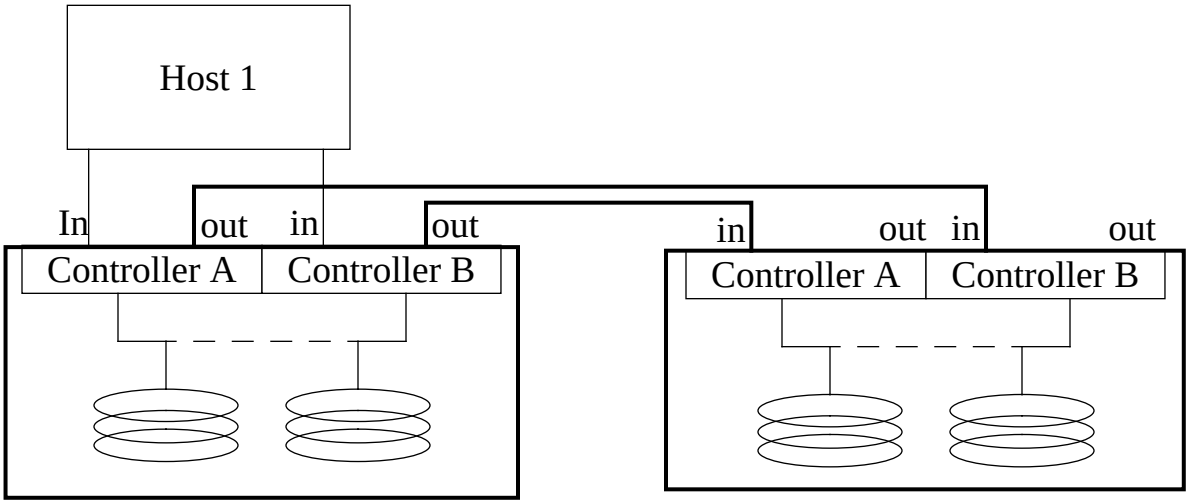
- Raid Manager 6.1 will have dual host and multi-initiator capability. The RSM Array 2000 can now be configured with Sun Cluster 2.0 software for a clustering solution and allow two hosts to share access to the same RSM Array 2000 disk array. In the multi-initiation environment, the two hosts will have shared access of the controllers and the LUNS assigned to the controllers. Both host and controller failover are supported.
- Configurations with two daisy-chained RSM Array 2000 is supported in the Sun clustered multi-initiation environment.
- 4-node cluster configuration will be announced after 10/97 in future Sun Cluster announcements.
- Redundancy provides disk array and host failover
- Additional SCI connector cable required between the Solaris hosts. Please refer to the SunCluster JTF documentation for details.
- RAID Manager 6.1 is required. Additional cable may be required for configuring the cluster like the SCI card for host failover or a 3-headed cable to configure 4-node clusters.

Box Sharing



- Two host systems can share the same RSM Array 2000 disk array.
- The two Solaris hosts are completely independent of each other and do not share each other's LUNs. That means each host is not aware of the other host's LUNs.
- There is no failover between controllers because each of the two controllers is assigned to one of two independent hosts.
- RAID Manager 6.1 is required and no additional hardware is required for the RSM Array 2000.

Daisy-chain Configuration



- Two RSM Array 2000 disk arrays can be daisy-chained to a pair of host adapters configured on a host system.
- Daisy-chain configurations only require the installation of RAID Manager 6.1, Solaris 2.5.1, and additional cables. No hardware upgrade is required.
- Single host daisy chain configuration can use the current 12-meter cable bundled with the RSM Array 2000. For cluster/daisy chain configurations, new shorter cables will be required; please refer to the SunCluster documentation for details.

Ultra Enterprise 10000 (Starfire) Dynamic Reconfigurating Support

- Allows the Ultra Enterprise 10000 user to reassign the RSM Array 2000 disk array from one UE10000 domain to another UE10000 domain and be recognized by another UE10000 domain without out requiring a domain reboot.
- RAID Manager 6.1 has an enhanced RDAC that checks for newly added devices.
- Only RAID Manager 6.1 is required; no hardware upgrade is required for the RSM Array 2000.

Year 2000 Compliance

- The RSM Array 2000 with RAID Manager 6.1 (Phase 2) will be year 2000 compliant.
- In Phase 1, the 2 digit “year field” is used in the logging facility within RAID Manager 6. In Phase 2, a full 4 digit “year field” will be implemented in the log file.

Other RAID Manager 6.1 Enhancements

- Increased mirror size from 20 drives to 30 drives. This allows users to mirror 15+15 drives in one RAID1 LUN.
- Added information to show how drives are mirrored in a logical representation. The RAID Manager 6.1 Graphical User Interface has been enhanced to show how drives are mirrored in a RAID 1 configuration.
- Frozen node names mapping LUNs to controllers even after a controller failover (check)
- User Defined Module selection/removal. Assign abstract names for each RSM Array 2000 RAID module instead of using the device name (dev/[r]RAID_Module_NN)

RSM Array 2000 System Architecture (cont'd)

RSM Array 2000 Phase 1 Software Requirements

- Solaris 2.4, 2.5, and 2.5.1
- RAID Manager with the RDAC driver ships with the RSM Array 2000 system and Xoption as an unbundled CD.

RSM Array 2000 Phase 2 Software Requirements

- Solaris 2.5.1 and later releases.
- RAID Manager 6.1with the RDAC driver ships with the RSM Array 2000 system and Xoption as an unbundled CD.

RSM Array 2000 and Veritas VxVM

Here a complete list of all the caveats, with abridged descriptions [Thanks to Brian Herzog's review].

- Installation: Installation ordering is very sensitive. Sun RSM Array 2000 installation procedures must be followed exactly as documented in the Sun RSM Array 2000 Product Release Notes, the Sun RSM Array 2000 System Manual, and the Sun RSM Array 2000 RAID Manager.
- Installation Guide:
  - Deviation from the following sequence can and will cause incompatibility between RSM Array 2000 and VxVM.
  - VxVM should be installed only after the following have been completed and validated:
  - Sun RSM Array 2000 hardware is properly installed and connected to the host
  - Sun RSM Array 2000 software is properly installed
  - Sun RSM Array 2000 devices (LUNs) are properly configured using RAID Manager
  - The host system is rebooted using the -r option
  - Upon reboot RAID Manager has recognized the configured LUNs and created the appropriate device nodes

Note that it is also important to ensure that startup scripts are modified as necessary to ensure that RSM Array 2000 daemons are invoked prior to VxVM.

- Device Naming
  - RSM Array 2000 device (LUN) entries which are put in /etc/vsftab, and which you plan to encapsulate using VxVM, must use the standard Solaris operating system device nodes, e.g., /dev/rdsk/c3t4d0s0.
  - Do not use the node names generated by RAID Manager, e.g., /dev/rRAID_module01/0s0.

- Boot Volumes
  - Sun RSM Array 2000 cannot be used as a boot device at this time. Therefore Sun RSM Array 2000 devices (LUNs) cannot be used to hold any part of the VxVM "rootdg" disk group.

- Controller Error Recovery
  - Follow Sun RSM Array 2000 controller error recovery procedures as documented in the Sun RSM Array 2000 product documents mentioned above.
  - Failure to do so can and will result in incompatibility with VxVM.

- Configuration
  - It is recommended that you not configure VxVM RAID 5 volumes built from Sun RSM Array 2000 devices (LUNs) in general, and not from Sun RSM Array 2000 RAID 5 LUNs in particular.

RAID Levels

High Data Availability with RAID Implementation

The RSM Array 2000 is a controller-based (hardware) RAID subsystem that enables users to achieve the ideal balance of high data availability, performance, capacity, and cost. Furthermore the RAID Manager software makes it easy for users to configure, monitor, or reconstruct array configurations while the server is operating.

– RAID 0 - striping	– Spreads data across multiple disk spindles for better performance – Can be tuned to optimize either random or sequential I/O performance – No redundant data protection, lower reliability than independent disks – Same low cost per usable megabyte as independent disks
– RAID 1 - Mirroring	– Maintains duplicate copies of data, so if a disk fails, data is available and applications keep running – Performance should be the same as independent disks. – Highest cost per usable megabyte
– RAID 0+1	– Duplicate copies of striped data remain available even if a disk fails – Co MBines performance of striping with data protection of mirroring – Has same cost per usable megabyte as mirroring
– RAID 3	– Good for large amounts of data transfers per I/O request and low I/O rates. When selecting RAID 3, RSM Array 2000 will actually implement RAID-5.
– RAID-5	– Striping with Parity. Data protection by storage of parity information so, so data remains available even if a disk fails Good for applications with high rates of I/O requests. – Stripes data across multiple disk spindles to optimize random or sequential performance – Higher cost per megabyte than independent disks or RAID 0, but much lower than RAID 1 or 0+1 – Lower performance on small-sized writes than in RAID 0, 1, 0+1 or independent disks

RAID Levels (cont'd)

- **Features**
  - Independent disks, plus RAID levels 0, 1, 0+1, and 5 are all available at the same time within the same array.
  - RAID groups may span multiple arrays.
  - RAID levels 5, 1, and 0+1 yield predicted steady-state uptimes in excess of 99.99 percent per array and mean time between data loss (MTBDL) in the millions of hours.
  - Hot spares are automatically swapped in to replace any failed disk in a RAID-5, 1, or 0+1 group.
  - RAID stripe sizes are adjustable to optimize for random or sequential I/O patterns.
- **Benefits**
  - Can easily match data layouts to meet users' specific requirements for capacity, performance, high availability, and cost
  - Greater flexibility; allows creation of fully redundant configurations
  - New levels of high availability for Sun systems, so users can be confident that data will not be lost
  - Continuous redundant data protection even if a disk fails; maintenance can be deferred for days, weeks, or even months when needed
  - Users can tune performance to their specific applications

RAID Tech Facts

- Hot spares are extra disk drives in the array that are powered up and ready to use. If a drive in a RAID-5, 1, or 0+1 volume fails, a hot spare drive is assigned and the RAID Manager detects the failure and automatically rebuilds the data from the failed drive onto a hot spare drive.
- Each array may have several hot spare drives.
- Striped data organizations (RAID 0, 0+1, 3, and 5) can be tuned to optimize for either random or sequential I/O performance. The RAID 3 and 5 implementations are the same (need to confirm with Sy MBios).
- To optimize for random performance, striping evenly balances the I/O load across disk spindles in the RAID. This is done by setting the stripe width as large or larger than the typical application I/O request. For ex Ample, if the typical I/O request is 8 KB, setting the stripe width to 64 KB might be appropriate. This tends to evenly distribute I/O requests across all the disk drives in the RAID, and a single disk drive services each I/O request.
- Sequential performance is optimized when data is spread out so that each application I/O request spans all the drives in the RAID group. This requires setting the stripe width so that it is small relative to the size of the typical I/O request. For ex Ample, in a RAID group four data disks wide, if typical application I/O size is 8 to 16 KB, a stripe width of 2 KB may be best.

RSM Array 2000 Performance Key Facts

- Redundant array of independent disks (RAID) functionality can be implemented on the array controller in or it can be implemented in the host in software. Each method has its advantages.
- When RAID is implemented on an array controller, separate from the host computer system, it is often termed “controller-based RAID.” Controller-based RAID is assumed to deliver higher performance than host-based RAID. The system I/O bus traffic is lower because the controller does the parity calculations. This design decreases host/array bus traffic, improves system I/O throughput, and allos a tight coupling of RAID management with nvram. The smart cache controller does all the multi-stripe IOs and performs prefetch. The controller converts small sequential I/O into full stripe I/O to improve RAID-5 performance. In host-based RAID systems, each read/write command requires multiple I/O requests to the disk which increases bus traffic and impacts I/O performance for RAID-5.
- The primary advantage of host-based software RAID is flexibility. In this type of implementation, software on the host system controls RAID configuration, as well as management and redundant data synchronization operations. This provides a high degree of flexibility, allowing many different RAID levels to be configured, and even allowing RAID groups to span multiple disk controllers. Host software RAID also enables configurations to be easily changed over time, as the user’s needs change.
- For typical I/Os of 8K block sizes, most beta customers found that the failover took seconds. In the worse situation, the failover may take up to 5 minutes.
- After a disk fails, the global hotspare automatically kicks in and your customer's data is immediately available. The time it takes to rebuild a drive counting from the time the replacement drive is inserted is 7 minutes to about an hour.
  - Minimum case senario: The rebuild time for a 2 GB RAID-5 LUN (9 X 4.2 GB disks, 64 KB interlace) was 6 minutes 20 seconds. The Raid-5 LUN was configured to achieve the fastest reconstruction performance.
  - Maximum "disk Full" senario: The rebuild time for a 32 GB RAID-5 LUN (9 X 4.2 GB disks, 64 KB interlace) was 1 hour 2 minutes. The Raid-5 LUN was configured to achieve the fastest reconstruction performance. This yields 4 GB of LUN per drive.

RAID Performance (cont'd)

RSM Array 2000 Performance RAID-5:

- (8 data disk & 1 parity disk @ 64KB buffer size)
- 1 GB of data seek range (16X the cache size)

Type	IO_Size	RSM Array 2000 IOPS	(MB/sec)
Seq Write	8K	3516	28.8
Seq Write	16K	2225	36.5
Seq Write	256K	226	59.2
Seq Write	512K	110	57.7
Seq Read	8K	1980	16.2
Seq Read	16K	2479	40.6
Seq Read	256K	242	63.4
Seq Read	512K	116	60.8

RSM Array 2000 Performance Raid-3:

- (8 data disk & 1 parity disk @ 64KB buffer size)
- 1 GB of data seek range (16X the cache size)

Type	IO_Size	RSM Array 2000 IOPS	(MB/sec)
Seq Write	8K	3536	29.0
Seq Write	16K	2224	36.4
Seq Write	256K	224	58.7
Seq Write	512K	110	57.7
Seq Read	8K	3056	25.0
Seq Read	16K	2355	38.6
Seq Read	256K	243	63.7
Seq Read	512k	122	64.0

RAID Performance (cont'd)

RSM Array 2000 Performance RAID-0:

– 6579 IOPS at 100% hits to cache.

RSM Array 2000 Performance Raid-0:

– RSM Array 2000 (17 & 18 disk LUN @16KB interlace stripe width)
– RSM 214 (18 & 18 disk LUN 8bit stripe width) with 2 volumes
– 1 GB of data seek range (16X the cache size)

Type	IO_Size	RSM Array 2000	
		IOPS	(MB/sec)
Rand Write	2K	4352	8.9
Rand Write	4K	3647	14.9
Rand Write	8K	3447	28.2
Rand Read	2K	1449	3.0
Rand Read	4K	1463	6.0
Rand Read	8K	1220	10.0

RSM Drive Module Performance

	4.2 GB 5400rpm	4.2 & 9.1 GB 7200rpm
Average Seek Read (ms)	10	9
Average Seek Write (ms)	11	10.5
Average Latency (ms)	5.54	4.17
Burst Data Rate (MB/s)	20	40
Data Transfer Rate (MB/s)	3.1 - 5.2	9
Rotational Speed (rpm)	5400	7200
Buffer (KByte)	512	512

RSM Array 2000 Features supported after Phase 2:

- Q3FY'98 and later:
  - Fibre Channel Arbitrated Loop interface to a single host will improve the throughput between the controller and host interface for even better performance.
  - Open RSM Array 2000 with limited availability in Q2FY98. Volume FCS in Q3FY98 for support of HP-UX and NT systems.
  - SyMON integration will provide system environmental monitoring using Sun's SyMON GUI. This will be the first step towards a common interface to Sun's disk subsystems.
  - System bootable from the RSM Array 2000 enhances the HA story.
  - JMAPI browser-based monitoring
  - Internationalization (I18N/L10N)
  - Dynamic LUN expansion

System Specification

RSM Array 2000 System Electrical Specifications (configured with 35x 9.1GB 7200rpm drives)

- Input Voltage — 200 - 240 VAC, single phase 50/60 Hz
- Input Current — 24 Amp
- Power Output — ~1150 Watts (4200 Watts max for site prep.)
- VA — ~2407 VA
- Heat Output — ~4219 BTU (14,450 BTU max for site prep.)
- Plug Type - U.S. — NEMA L6-30P for 200-240 VAC
- Plug Type - International — IEC 309, 32A, 250V

RSM Array 2000 Controller Module Electrical Specifications

- Input Voltage — 200-140 VAC 50/60 Hz
- Input Current — 1.0 Amp
- Power Output — 150 Watts
- VA — 157 VA
- Heat Output — 510 BTU

Racked Mounted - 5 RSM Trays Electrical Specifications

- Input Voltage — 200-240 VAC 50/60Hz
- Input Current — 24 Amps
- Power Output — ~1000 Watts/5 trays (4200 Watts max for site prep)
- VA — ~2250 VA/5 trays
- Heat Output — ~1385 BTU/5 trays (14,450 BTU max for site prep)

BTU = Watts * 3.41

VA = Watts * 1.34

	Watts	VA	BTU
RSM Array 2000 Controller	150	157	510
5 RSM Drive Tray with SEN Card	1000	2250	1385
35* 4.2GB 7200rpm Drives	--	--	35*45.5=1593
35* 9.1GB 7200rpm Drives	--	--	35*66.4=4219

RSM Array 2000 Power Consumption

- RSM Array 2000 15x4GB 5400rpm 2700 BTU (~806 Watt) - EOL'd Q1FY98
- RSM Array 2000 35x4GB 5400rpm 3600 BTU (~1055 Watt) - EOL'd Q1FY98
- RSM Array 2000 15x4GB 7200rpm 2600 BTU (~762 Watt)
- RSM Array 2000 35x4GB 7200rpm 3250 BTU (~953 Watt)
- RSM Array 2000 15x9GB 7200rpm 2850 BTU (~835 Watt)
- RSM Array 2000 35x9GB 7200rpm 3800 BTU (~1114 Watt)

RSM Array 2000 System and Controller Module Environmental Specification

Temperature Range (dry bulb)

• Operating	5 to 35 degrees C (41 to 95 degrees F)
• Non-Operating	-20 to 60 degrees C (-4 to 140 degrees F)

Relative Humidity

• Operating	20% to 80% RH @ 27 C, maximum wet bulb non-condensing
• Non-Operating	93% RH non-condensing

Sound Power Emission - Declared noise emissions in accordance with ISO 9296

• Operating	7.1B LWAd (1B = 10dB)
• Non-operating	7.1B LWAd (1B = 10dB)

Operating Altitude

• Operating	3 Km (10,000 feet)
• Non-Operating	12 Km (40,000 feet)

RSM Array 2000 System and Controller Module Shock & Vibration Specification

Shock

• Operating	3 Gs 11 ms
• Non-Operating	15 Gs 11ms

Vibration

• Operating	0.10 inches double Amplitude 5-18Hz 0.15 Gs 18-500Hz
• Non-Operating	0.10 inches double Amplitude 5-10Hz 0.5 Gs 10-500Hz

RSM Array 2000 System Physical Specifications

• Height	143 cm / 48 in.
• Width	77 cm / 30 in.
• Depth	99 cm / 39 in.
• Weight (empty rack)	170 Kg / 375 lb +/- 25 lb
• Weight (Power Sequencer)	6.8 Kg / 15 lb
• Clearance & Service Area	122 cm / 48 in. front
•	92 cm / 36 in. back
•	5 cm / 2 in. sides

Controller with Bezel Physical Specifications

• Height	176.3 mm / 6.94 in.
• Width	445 mm / 17.50 in.
• Depth	609.6 mm / 24.00 in.
• Weight (Enclosure)	13.6 Kg / 30 lb
• Weight (Controller Module)	37.2 Kg. / 82 lb
• Weight (Power Supply)	1.5 Kg. / 3.3 lb
• Weight (Fan)	0.9 Kg. / 2.0 lb
• Weight (Battery)	10.9 Kg. / 24 lb
• Weight (1 Controller Board)	2.9 Kg. / 6.5 lb
• Bezel Thickness	0.375 to 0.875 in.

RSM Disk Tray Physical Specifications

• Height	12.8 mm / 5.05 in.
• Width	44.5 mm / 17.5 in.
• Depth	46.8 mm / 18.44 in.
• Weight (2 power modules)	14.4 Kg / 31.6 lb.
• Weight (1 disk module)	~1.2 Kg. / ~2.7 lb.

RSM Array 2000 Regulation

Safety Regulation	
• Safety	• UL1950, • CSA C22 No.950, • EN60950 (TUV), • CB Scheme (to IEC 950 and Nordic deviations.)
• RFI/EMI	• VCCI Class 1. • FCC Class A. • DOC Class A. • EN55022 Class A. • EN61000-3-2.
• Immunity	• EN50082-1
• Product Label	• FCC Class A • VCCI Class 1 • Industry Canada Class A • UL Mark • CUL Mark • TUV Mark • CE Mark

RSM Array 2000 System Marketing Part Numbers

Part Number	Option Description	Comments
6532A	Build To Configure - RSM Array 2000 147GB (15 x 4.2 GByte 7200rpm 128 MB Cache Memory) This is BUILD TO ORDER with 15 to 35 drives.	Requires two (X)1065A or X1062A Requires two 3800A/3848A
X6533A	RSM Array 2000 147GB (35 x 4.2 GByte 7200rpm 128 MB Cache Memory)	Requires 2 X1065A or X1062A Requires 2 X3800A/X3848A
X6534A	RSM Array 2000 136GB 5 trays (3x9.1 GB 7200rpm 128 MB Cache Memory)	Requires 2 X1065A or X1062A Requires 2 X3800A/X3848A
X6535A	RSM Array 2000 318GB 5 trays (7x9.1 GByte 7200rpm 128 MB Cache Memory)	Requires 2 X1065A or X1062A Requires 2 X3800A/X3848A
X6536A	RSM Array 2000 Controller Rack Mount 128 MB Cache Memory	Requires 2 X1065A or X1062A Requires 2 X3800A/X3848A May require five X6510A SEN card
* Note:	All RSM Array 2000 system configurations include two RAID controller boards in one controller module, as well as five SEN cards.	
X7020A	RSM Array 2000 64 MB Add-on Cache Memory	Order two 64 MB add-on memory - one for each of two controller board.
NF-INST-SSA	ARRAYStart Onsite Installation *** CONTACT SUN SERVICE REP TO ORDER	Recommended one installation contract per RSM Array 2000
SBUS Host Adapter		
X1065A	UDWIS/S - Sbus Ultra Differential F/W Intelligent SCSI host adapter (40 MB/sec)	Recommend for optimum performance
X1062A	DWIS/S - Sbus Differential F/W Intelligent SCSI host adapter (20 MB/sec)	
Disk Drives & RSM Trays Options		
X6506A	4.2 GB 5400rpm Fast/Wide SCSI-2 Disk for RSM	Add on drive for RSM trays

Part Number	Option Description	Comments
X6503A	3x 4.2 GB 5400rpm RSM tray	Tray for upgrading to RSM Array 2000 system
X6504A	7 x 4.2 GB 5400ron RSM Tray	Tray for upgrading to RSM Array 2000 system
X6509A or 6509A	4.2 GB 7200rpm Fast/Wide SCSI-2 Disk for RSM 6509A for “Build To Order”	Add on drive for RSM trays
X6503A	3x 4.2 GB 7200rpm RSM tray	Tray for upgrading to RSM Array 2000 system
X6504A	7 x 4.2 GB 7200rpm RSM Tray	Tray for upgrading to RSM Array 2000 system
X6516A	9.1 GB 7200rpm Drive Module for the RSM Array 2000	Add on drive for RSM trays
X6514A	3 x 9.1 GB 7200rpm RSM Tray	Tray for upgrading to RSM Array 2000 system
X6515A	7x 9.1 GB 7200rpm RSM	Tray for upgrading to RSM Array 2000 system
X6510A	RSM Tray SEN Card	Required for environmental monitoring of RSM trays.
RSM Array 2000 Accessories		
X956A	Enterprise expansion cabinet	
X3800A	Power cord for RSM Array 2000 and SPARCstorage Array Model 214 RSM - US	
X3848A	Power cord for RSM Array 2000 and SPARCstorage Array Model 214 RSM - International	
X6513A	Power sequencer for the Enterprise Expansion Rack	
#180-1189-01	U.S. power cord for connecting UE 2 server to the RSM Array 2000 power sequencer	Required for grounding the UE2 server to the RSM Array 2000
#180-2190-01	International power cord for connecting UE 2 server to the RSM Array 2000 power sequencer	Required for grounding the UE2 server to the RSM Array 2000
#530-2197	U.S. and International power cord for connecting UE 2 server to the RSM Array 2000 power sequencer	Required for grounding the UE2 server to the RSM Array 2000
X3835A	3-connector SCSI cable for SunCluster configuration	Required for 4-node clusters

Part Number	Option Description	Comments
X6225A	400-GByte 8mm SPARCstorage Library	Rack mounted device for tape backup
Field-replaceable spare parts		
#530-2369	Cable, Key Switch	
#370-2439	32 MB SIMM, RSM Array 2000 cache memory	
#370-2438	8 MB SIMM, RSM Array 2000 processor memory	
#370-2436	RSM Array 2000 power supply -customer replaceable unit	
#370-2435	RSM Array 2000 controller canister	
#370-2434	RSM Array 2000 battery canister	
#370-2433	RSM Array 2000 controller fan, customer replaceable unit	
#370-2432	RSM Array 2000 power supply fan, customer replaceable unit	
#370-2431	Empty RSM Array 2000 enclosure	
#370-2724	Battery Cable	
#370-2869	Asse MBly, Power Supply Backpanel	
#370-2870	12V cable	
#370-2871	5V cable	
#300-1311	SPARCstorage RSM tray power supply	
#370-2196	SPARCstorage RSM SCSI tray interface card	
#370-2197	SPARCstorage RSM fan module (has 2 fans)	
#370-2443	UDWIS/S host adapter	
#540-?	RSM 4.2 GB 7200rpm disk drive module	
#540-?	RSM 9.1GB 7200rpm disk drive module	
#540-2784	RSM 4.2 GB 5400rpm disk drive module	

RSM Array 2000 Configuration

RSM Array 2000 Configuration Guidelines

RSM Array 2000 will be supported in the following systems.

Host Platform
Ultra Enterprise 10000 Ultra Enterprise 6000 Ultra Enterprise 5000 Ultra Enterprise 4000 SPARCcenter 2000E/2000 SPARCserver 1000E/1000 Ultra Enterprise 3000 Ultra Enterprise 2

RSM Array 2000 - A Terabyte Solution

RSM Array 2000 can be configured with Ultra Enterprise Server, SPARCcenter 2000E, and SPARCserver 1000E customers to achieve terabytes of storage.

The maximum storage capacity with one RSM Array 2000 rack is given below. The maximum capacity for the Ultra Enterprise 10000 configuration could be higher than given below.

Server Platform *without daisy-chained disk array	Host Bus Adapters Required	Maximum number of RSM Array 2000 Single/DaisyChain	Max Capacity 4.2 GB & 9.1 GB Single/DaisyChain
Ultra Enterprise 10000	52	26/34	3.8/9.1T & 8.2/10.8T 17TB after completing SSQA testing
Ultra Enterprise 6000	36	18/36	2.6/5.2T & 5.7/11T
Ultra Enterprise 5000	18	9/18	1.3/2.6T & 2.8/5.7T
Ultra Enterprise 4000	18	9/18	1.3/2.6T & 2.8/5.7T
SPARCcenter 2000E/2000	36	18/36	2.6/5.2T & 5.7/11T
SPARCserver 1000E/1000	12	6/12	0.9/1.8T & 1.9/3.8T
Ultra Enterprise 3000	12	6/12	0.9/1.8T & 1.9/3.8T
Ultra Enterprise 2	4	2/4	294/588GB & 637/1274GB

RSM Array 2000 Configuration (cont'd)

Other Configuration Guidelines

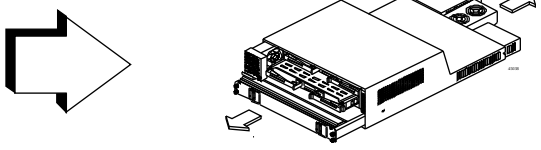
- The RSM Array 2000 ships with a 12-meter, differential Ultra SCSI cable. Shorter cables are available as xoptions (see ordering information).
- When ordering the RSM Array 2000 systems, you must order a power cord kit (X3800A for the U.S. and X3848A for international) as a separate line item.
- Each RSM Array 2000 needs to interface to the host using two UDWIS/S host bus adapters to optimize performance. Some customers may already have a DWIS/S host bus adapter; DWIS/S is also supported on the RSM Array 2000.
- The RSM Array 2000 includes two power sequencers for full redundancy.
- If the customer has an RSM 214 and only wants to swap the Model 2xx controller with the RSM array 2000 controller, order the Xoption (X6536A).
  - The RSM 214 system may only have one power sequencer. Customers should order a second power sequencer and a second power cord kit (X3800A for the U.S. and X3848A for international) as separate line item.
  - Refer to the upgrade section for more information.
- Cable lengths:
  - External differential Ultra SCSI cable is 12.0 meters
  - UDWIS/S and DWIS/S host bus adapter, 0.1 meter of internal cable length.
  - RSM Array 2000 system, 0.1 meter of internal cable length.

Upgrades to the RSM Array 2000

Upgrading to the RSM Array 2000 system is simple.

- System swap, buy a RSM Array 2000 system, return qualifying storage components, and receive a reduced price.
- Controller swap, exchange the Model 210 controller with the RSM Array 2000 controller. This upgrade is recommended only if the customer already has a SPARCstorage array RSM 214. The program will let customers trade-in the older controller for a reduced price on the RSM Array 2000 controller. There are two RSM 214 configurations in the installed base. You will need to know which configuration is being upgraded to determine what additional parts will be required.
  - RSM 214 in an Enterprise expansion rack; you will need the new controller module (X6536A), a second power sequencer, a second wall power cable, possibly 5 SEN cards, and 2 UDWIS/S host adapters.
  - RSM 214 in a SPARCcenter expansion rack; you will only need the new controller module (X6536A), possibly 5 SEN cards, and 2 UDWIS/S host adapters.
- Customer can install their existing 5 RSM disk trays using the existing 5 SCSI cables to the new RSM Array 2000 controller. There were 6 RSM disk trays in their older RSM 214 system, configure the sixth tray with their DWIS/S host adapter to the system. When upgrading to a RSM Array 2000 system, the customer site may need to add an additional 220 AC outlet for the second power sequencer. Customers should check their existing storage system's total capacity prior to ordering to the RSM Array Upgrade to make sure they have enough storage capacity to hold all the data. They may have to order additional disk upgrades with the subsystem upgrade.

Model 2xx Controller from the RSM 214

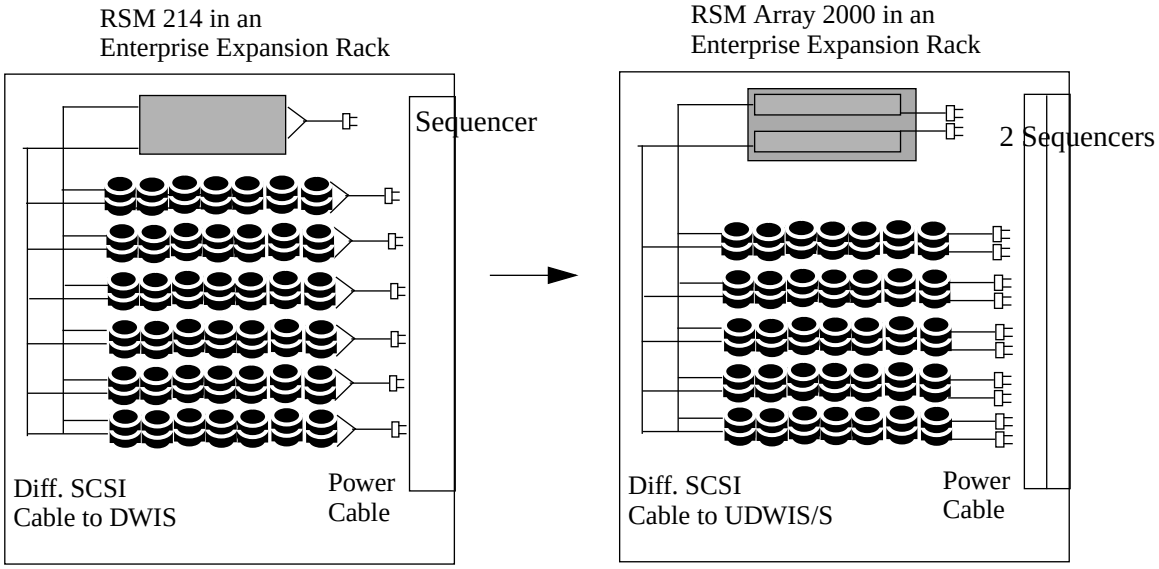


Upgrading Using a Controller Swap

1) Replacing the SSA Model 210 controller with the RSM Array 2000 controller in an Enterprise Expansion Rack

Sun recommends that customers use the upgrade package UG-RSM2000-CBR to ensure their hardware is upgraded to current specs. If customers insist on doing their own upgrades, read the following. Configuring the RSM Array 2000 controller module in an existing Enterprise expansion rack requires a second power sequencer and replacement of the RSM power cables for a higher level of hardware redundancy. Customers may need to replace older RSM tray enclosures to accomodate new and faster 7200rpm drives.

- Swap the Model 210 controller with the RSM Array 2000 controller xoption.
- RSM trays shipped before 3/1/97 need to be upgraded. Replace/keep the five of the existing RSM trays and five pairs of differential SCSI cables. Move the sixth RSM tray to another storage rack or direct attach the RSM disk tray to the host through the DWIS/S host adapter.
- The redundant RSM Array 2000 configuration needs a) 10 single power cables to connect the 5 RSM trays to 2 power sequencers and b) 2 power cables to connect the RSM Array controller module to the 2 power sequencers. The Enterprise expansion cabinet should already have 8 single power cables; the controller xoption includes 4 more power cables. This will provide the 12 power cables needed to complete the installation.
- The controller xoption also includes: two 12-meter host cables, and two terminators.
- Two UDWIS/S host adapters should be ordered for Ultra SCSI performance. Otherwise, the customer can use their existing DWIS/S host adapters.

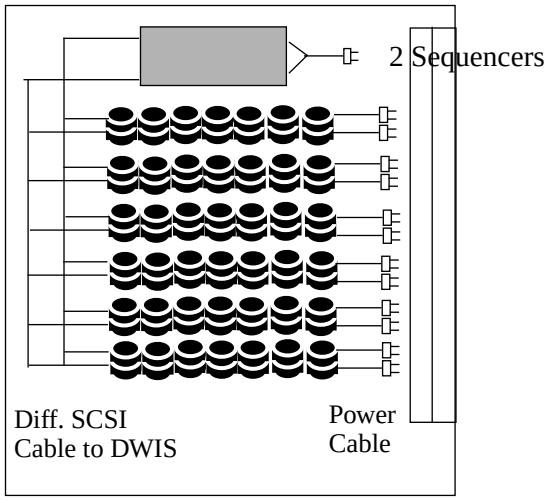


2) Replacing the SSA Model 210 controller with the RSM Array 2000 in an SPARCcenter Expansion Rack

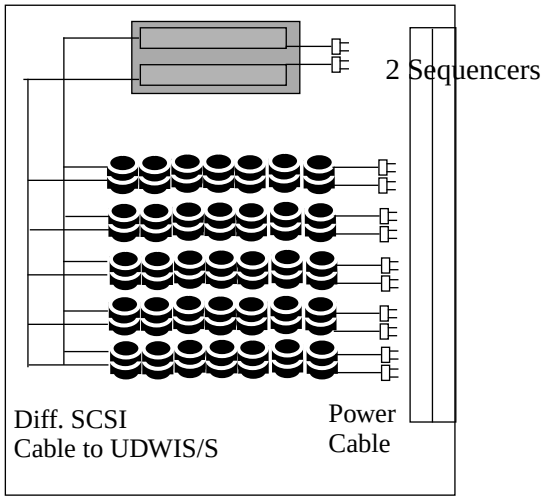
Sun recommends that customers use the upgrade package UG-RSM2000-CBR to ensure their hardware is upgraded to current specs. If customers insist on doing their own upgrades, read the following. Configuring the RSM Array 2000 controller in a SPARCcenter expansion rack requires replacing the Model 210 controller with the RSM Array 2000 controller module. Customers may need to replace older RSM tray enclosures to accomodate new and faster 7200rpm drives.

- RSM trays shipped before 3/1/97 need to be upgraded. Replace/keep the five of the existing RSM trays and five pairs of differential SCSI cables. Move the sixth RSM tray to another storage rack or direct attach the RSM disk tray to the host through the DWIS/S host adapter.
- The redundant RSM Array 2000 configuration needs 12 single power cables to connect the controller and the RSM trays to 2 power sequencers. The Enterprise expansion cabinet already has 10 single power cables. The controller xoption has 4 more power cables; use two and save the remaining 2 for future use.
- The controller xoption also includes: two 12-meter host cables, and two terminators.
- Two UDWIS/S host adapters should be ordered for Ultra SCSI performance. Otherwise, the customer can use their existing DWIS/S host adapters.

RSM 214 in an
SPARCcenter Expansion Rack



RSM Array 2000 in an
SPARCcenter Expansion Rack



3) Other hardware required when swapping the Model 210 with the new RSM Array 2000 controller:

Assume the customers already have five RSM disk trays. In addition to upgrading the RSM Array 2000 controller, the customer also needs to order:

- 5 SEN Cards for 5 RSM disk trays if needed (X6510A)
- A second power sequencer (X6513A) and a second wall power cable
- 2 UDWIS/S host adapter cards (X1065A)

Upgrades to the RSM Array 2000 (cont'd)

Part Nu MBer	Option Description	Comments
Controller Upgrade		
UG-RSM2000-CBR	Ugrade to RSM Array 2000 Controller Module from SSA 214. Includes Enterprise storage rack and five empty RSM tray enclosures.	Customer returns older Enterprise storage rack, five older RSM tray enclosures, and SSA 2xx controller module
UG-RSM2000-CB **EOL'd**	Storage Controller Upgrade to RSM Array 2000 Dual Redundant RAID Controller(X6536A)	Replaced by UG-RSM2000-CBR.
Upgrade SSA to RSM Array 2000 - System Swap		
UG-RSM2000-4	Storage Array Upgrade to RSM Array 2000 63GB (15 x 4.2 GB 5400 rpm 128 MB Cache Memory)	Customer Returns Minimum of 15 GB of Sun storage of at least 1.05GB per drive. Floppies and Non-Sun drives are not accepted.
UG-RSM2000-4FST	Storage Array Upgrade to RSM Array 2000 147GB (35 x 4.2 GB 7200 rpm 128 MB Cache Memory)	Customer Returns Minimum of 50GB of Sun storage of at least 1.05GB per drive. Floppies and Non-Sun drives are not accepted.
UG-RSM2000-9FST	Storage Array Upgrade to RSM Array 2000 136GB (15 x 9.1 GB 7200rpm 128 MB Cache Memory)	Customer Returns Minimum of 30 GB of Sun storage of at least 1.05GB per drive. Floppies and Non-Sun drives are not accepted.
RSM Disk Modules		
UG-2DSK-RSM-9FST	RSM Disk Upgrade to 2 x 9.1 GB 7200rpm Drive Module	Customer Returns Minimum of 4GB of Sun storage of at least 1.05GB per drive. Floppies and Non-Sun drives are not accepted.

SunSpectrum℠ Customer Service Program

SunSpectrum℠ support programs are designed to meet customers' complete system needs, from total business support to self-maintenance and any level in-between. The SunSpectrum program supports a flexible range of services, allowing customers complete systems coverage for hardware, software, network applications, and network interoperability problems. A single fee covers the support for customers' entire systems—no matter what the configuration—making ordering and support administration easy. Customers should check with their local customer support representative for program/feature variance and availability in their area.

Services	SunSpectrum Platinum℠ program	SunSpectrum Gold℠ program	SunSpectrum Silver℠ program	SunSpectrum Bronze℠ program
Telephone assistance	Seven-day, 24 hour	Seven-day, 24-hour	8AM-8PM, M-F	8AM-5PM, M-F
On-site response	Seven-day, 24-hour	8AM-8PM, M-F	8AM-5PM, M-F	
Customer-defined priority	✔	✔	✔	
Urgent (phone/on site)	Live/two hour	Live/four hour	Live/four hour	Four hour/NA
Serious (phone/on site)	Two hour/four hour	Two hour/next day	Two hour/next day	Four hour/NA
Noncritical (phone/on site)	Four hour/customer convenience	Four hour/customer convenience	Four hour/customer convenience	Four hour/NA
Remote dial-in analysis	✔	✔	✔	✔
Replacement hardware parts	On-site technician	On-site technician	On-site technician	Courier, two business days
Solaris™ enhancement release	✔	✔	✔	✔
Patches & maintenance release	✔	✔	✔	✔
SunSolve™ license	✔	✔	✔	✔
EarlyNotifier™ service	✔	✔	✔	✔
7-day, 24-hr phone coverage	✔	✔	Option	
7-day, 24-hr on-site coverage	✔	Option	Option	
2-hour on-site response	✔	Option	Option	
Self-paced education library	✔	✔	Option	
Personal technical acct. support	✔	✔	Option	
On-site technical support review	Quarterly	Semiannual	Option	
Technical support plan	✔			
99% server uptime guarantee	✔			
Coaching and training service	15 days per year			
Additional contacts	Option	Option	Option	Option
Unbundled software enhancement releases	Option	Option	Option	Option
On-site support (dedicated)	Option			

Glossary

Active Termination, Regulated	Terminates the SCSI bus with a series of resistors tied to +5 Volts. The terminator is labeled *Regulated* but is often referred to as *Active Terminator.*
Bandwidth	A measure of the capacity of a communication channel, usually specified in MB/sec.
CLI	Command Line Interface
Data Cache	64 MB to 128 MB DRAM SIMM cache memory (per controller board) for fast write to cache and read ahead cache operations. Cache memory permits intermediate storage of read and write data without physically reading/writing to the disk to increase overall performance.
Device Name	Software device address that identifies the controller/LUN. cXtYdZs0 where X is the host bus adapter, Y is the controller, and Z is the LUN. s0 slice nu MBer is used by the system, not by RAID Manager.
Disk array	A subsystem that contains multiple disk drives, designed to provide performance, high availability, serviceability, or other benefits.
Drive Group	A physical set of drives in the RAID Module. Drive groups are defined during configuration.
DWIS/S	SBus Differential fast/wide Intelligent SCSI-2 host adapter.
Fast SCSI	Data transfer rate of 10 MB/sec.
Fast Write	Allows disk write commands to be safely acknowledged to the host system as completed before the data is actually written to the disk media. This can be enabled/disabled through RAID Manager.
Fast/wide SCSI	Data transfer rate of 20 MB/sec. Wide devices can be connected to a standard SCSI interface but the extra data lines need to be terminated.
GB or GByte	A disk GB is 1 billion (1,000,000,000) bytes. A memory GB is 1,073,741,824 bytes (2 to the 30^{th} power).
GUI	Graphical user interface. The SPARCstorage™ Volume Manager provides a powerful, easy-to-use GUI.
Half-duplex	Refers to an interface, such as SCSI, that can transmit data in only one direction at a time. See full-duplex.
Host adapter	A device card that connects a peripheral device I/O protocol and medium to the computer system's I/O bus.
Hot Plug	The ability to remove, replace or add a device while current I/O processes continue on the bus.
Hot Spare	A drive in an array that is held in reserve to replace any other drive that fails. After a reconstruction, the hot spare drive is returned to the standby status.
Hot Swap	The specific case of Hot Plug which involves replacing a device with another of the same size, type, and layout.
IOPS	Input/output operations per second. A measure of I/O performance, this is usually used to quote random I/O performance. See throughput.

Glossary (cont'd)

LUN	Logical Unit is a set of physical drives sharing the same RAID level. Each LUN is seen by the operating system as one virtual drive.
MTBF	Mean time between failures. A measure of reliability, this is the average expected time between failures of equipment, usually measured in operating hours.
MTBDL	Mean time between data loss. In a RAID, this is the average expected time between two rapid disk failures that would cause irreparable data loss.
Parity	Additional information stored along with t he data that allows the controller to reconstruct lost data on RAID 1, 3, or 5 if a single drive fails
Reconstruction	Process used to restore a degraded RAID 1, 3, or 5 LUN to its original state after replacing a single failed drive.
RDAC	Redundant Disk Array Controller is an I/O driver in the RAID Manager software. The driver manages data I/O and failover rerouting of active I/O operations.
RAID	Redundant array of independent disks, a set of disk drives that appears to be a single logical disk drive to an application such as a database or file system. Different RAID levels provide different capacity, performance, high availability, and cost characteristics.
RAID Module	A set of drives, controllers, power supplies and cooling.
RAS	Reliability, availability, and serviceability. Features that enhance these attributes, including hot-pluggable capability, and redundancy. Important for keeping mission-critical application data on-line.
RAID Manager	RAID Manager software.
SCSI Address	The octal representation of the unique address (0–7) assigned to a narrow device; or hex representation of the unique address (0–15) assigned to a wide SCSI device.
Single Connector	A SCSI disk connector technology co-invented by Sun Microsystems. The Single Connector attachment (SCA) provides all SCSI, power, and control signals in a single connector, and enables easy servicing and highly reliable, pluggable disk drives.
SNMP	Simple Network Management Protocol notification is a feature to send remote notification of RAID events to designated network management stations. This is not supported at FCS.
Striping	Spreading, or interleaving, logically contiguous blocks of data across multiple independent disk spindles. The amount of data written on each disk before moving to the next drive is the stripe width.
Terabyte (TB)	A disk terabyte is 1 trillion (1,000,000,000,000) bytes. A memory terabyte is 1,099,511,627,776 bytes (2 to the 40^{th} power).
Throughput	A measure of sequential I/O performance, quoted in MB/sec. See IOPS.

Glossary (cont'd)

Volume	In the SPARCstorage Volume Manager, a volume is a virtual disk partition into which a file system, DBMS, or other application can place data. A volume can physically be a single disk partition or multiple disk partitions on one or more physical disk drives. Applications that use volumes do not need to be aware of their underlying physical structure. The Volume Manager handles mapping of virtual partition addresses to physical addresses.
Warm Plug	The ability to remove, replace or add a device while power is still applied only while all I/O processes are suspended.
Ultra SCSI	Data transfer rate of 40 MB/sec.
XOR	eXclusive OR. A binary mathematical operation performed on data to produce parity information. In RAID level 5, parity is generated from user data and is used to regenerate any data lost due to a drive failure.

Materials Abstract

All materials are available on SunWIN, except where noted otherwise.

Collateral	Description	Purpose	Distribution	Token # or Hibbert order #
Sales Tools				
Sun RSM Array 2000 Just the Facts	Reference guide for the Sun RSM Array 2000	Sales Tool	SunWIN	62264
SunIntro	Sun introduction with pricing and Q&A	Sales Tool	SunWIN	62208
Sun Enterprise Storage Solutions Presentation	Slide Presentation & Speaker Notes	Sales Tool	WWPM	62638, 62642, 62654
RSM Array 2000 Customer Presentation 3/97	Customer Slide presentation & Speaker Notes	Sales Tool	SunWIN,	57669 66257
Website				
http://skool.corp/nasc/groups/system_group/sonoma/index.html	Technical inforamtion for the Sun RSM Array 2000	Sales Tool	Web page	N/A
http://storageweb.eng or http://rocknroll.corp	Storage Products Business Unit Website with datasheet, product information, & competitive information	Sales Tool	Web page	N/A
Training				
NPI Kit	Field sales training slides	Training	Lance Lawson & SunWIN	61506
SRT Slides	Support Readiness Training http://skool.corp/nasc/groups/system_group/sonoma/index.html	Training	SunWIN	web page
Sales Training Video Tour	Sales training video	Training	Video	N/A
Support Training Video	Video for system installation	Training	Video	N/A
Sun U - RSM Array 2000 Web-training	Ongoing training for SE & SSE	Training	Web training in SunU	N/A
Sun U - RSM Array 2000 Lab Class	Ongoing training for SE & SSE	Training	Classroom	N/A

Collateral	Description	Purpose	Distribution	Token # or Hibbert order #
Product literature				
Sun RSM Array 2000 Datasheet	2 page color datasheet	Sales Tool	Field distribution	59624
Storage Reference Card	Sun Product Reference Card	Sales Tool	SunWIN	32118
RSM Array 2000 Product Brief	Two-page product information	Sales Tool	SunWIN	62328
White Papers				
RSM Array 2000 Architecture White Paper	Controller-based RAID backgrounder	Reference	SunWIN	62293
KPMG Peat Marwick & Sun	Performance study	Reference	SunWIN	62214
Andersen Consulting & Sun: Creating Breakthrough Business Strategies for the Datacenter	Performance study	Reference	SunWIN	62273
Sybase Performance White Paper	Performance study	Reference	SunWIN	TBD